

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

- PROTOCOL -

**RULE 1174 IGNITION METHOD COMPLIANCE
CERTIFICATION PROTOCOL**

February 28, 1991

**SOURCE TESTING AND MONITORING BRANCH
APPLIED SCIENCE AND TECHNOLOGY DIVISION
FORMERLY TECHNICAL SERVICES DIVISION**

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RULE 1174 IGNITION METHOD COMPLIANCE CERTIFICATION TESTING PROTOCOL

1. OVERVIEW AND APPLICABILITY

The South Coast Air Quality Management District's Governing Board adopted Rule 1174, Control of Volatile Organic Compound Emissions from the Ignition of Barbecue Charcoal, at its October 5, 1990 meeting. This new rule becomes effective January 1, 1992 and imposes an emission limit of 0.02 pound of volatile organic compounds (VOC) per start resulting from barbecue charcoal ignition. By the effective date, all products for the ignition of barbecue charcoal--other than electric starters (probes), chimneys using paper tinder, natural gas, or propane--will require testing to certify compliance with the 0.02 pound per start emission limit for volatile organic compounds (VOC) before they can be supplied, offered for sale, sold within the District's jurisdiction.

This protocol has been developed to ensure standardization of compliance certification test procedures including the use of: specified test facilities and test conditions, required test methods, specifications for test equipment, data collection/reporting and quality assurance requirements.

An independent testing laboratory, approved by the District, shall conduct the testing and prepare a report of findings,

including all raw data sheets/charts and laboratory analytical data. This report and a request for product certification must be submitted to the Executive Officer. The testing must demonstrate to the satisfaction of the Executive Officer that VOC emissions resulting from the ignition of the barbecue charcoal are less than or equal to 0.02 pound per start before Rule 1174 product compliance certification approval is granted.

Once approved, an emissions certification seal may be affixed to the product label indicating compliance with SCAQMD Rule 1174 emission limitations. The use of a certification seal will be reviewed by the District during the Certification process and shall contain the certification date and duration, the appropriate certification report reference, and other information deemed relevant to the certification process.

When an ignition product does not fall within the testing guidelines of this protocol, the protocol may be modified following an equivalency determination and written approval of the Executive Officer.

2. METEOROLOGICAL AND ENVIRONMENTAL CRITERIA

Testing can only be conducted when the inlet combustion air temperature is 60 to 80°F with a relative humidity of 20 to 80%; the relative humidity and temperature, where the charcoal and ignition method are stored 72 hours before test, is 45 to 65% and 65°F to 75°F respectively; and the outside wind speed including gusts may be no more than 10 mph if the test stack is exhausted outdoors.

Wind speed does not have to be monitored if stack is vented indoors. Indoor air must be stagnant. All these values must be monitored and recorded before, during, and after the test.

3. DEFINITIONS

For the purposes of this test protocol, the following definitions shall apply:

- (a) **Baseline VOC Emissions (E_b)** are the 0.008 pounds per start volatile organic compound mass emissions (calculated as CH_2) resulting from the ignition of charcoal by electric probe as referenced in Figure 1 of the SCAQMD's September 1990 report entitled "Emissions of Volatile Organic Compounds from Various Charcoal Ignition Methods".
- (b) **Emission Limit for VOC** is 0.02 pounds per start of Resultant VOC Emissions (E_r).
- (c) **Equivalent** - equipment that has been demonstrated to meet or exceed the performance, design, and operation specifications of the prescribed equipment. A demonstration of equivalency requires written approval from the Executive Officer both prior to compliance certification testing, based on an evaluation of comparative performance specifications and/or actual performance test data, and subsequent to submittal and evaluation of compliance certification data using this equipment.

- (d) **Ignition** is the ready to cook condition of the charcoal determined by the temperature above the charcoal, the organic vapor analyzer (OVA) concentration, and percent ash.
- (e) **Ignition VOC Emissions (e_i)** are the pounds per start total VOC mass emissions (expressed as CH_2) resulting from the ignition of charcoal by the ignition method undergoing evaluation, including both charcoal and ignition method emissions.
- (f) **Independent Testing Laboratory** is a testing laboratory that meets the requirements of District Rule 304, Section (1).
- (g) **Labeled Directions** - are those directions affixed to the ignition product which specify: 1) the amount of ignition product to use per pound of charcoal, unless the ignition product is already impregnated or treated in the charcoal; 2) how to use or apply the ignition product; and 3) how and when to light the ignition product.
- (h) **Percent Ash** is a qualitative observation of the ratio of visible charcoal surface area ignited (grayish/white ash) to total charcoal surface area times 100.
- (i) **Reference VOC Emissions (e_{ep})** are the pounds per start VOC mass emissions (calculated as CH_2) resulting from the ignition of charcoal by the reference electric probe during the certification testing.

- (j) **Resultant VOC Emissions (E_r)** are the Ignition VOC Emissions (E_i) less the Reference VOC Emissions (E_{ep}) plus Baseline Emissions (E_b).
- (k) **Start** is a 25 minute period commencing from the instant that emissions may be released from the product, either by evaporation or combustion, and further characterized such that by the end of said 25 minute period ignition is achieved.
- (l) **VOC Emissions (E)** are those emissions measured as volatile organic compound emissions (VOC expressed as CH_2) as defined in Rule 1174 and determined by using District Source Testing Method 25.1 including additions and exceptions identified within this document.

4. TEST STRUCTURE, EQUIPMENT SPECIFICATIONS, AND REFERENCE MATERIALS

This section specifies the standard test structure components, reference barbecue grill, test equipment, and reference charcoal required to implement the protocol. The test structure is to be constructed as shown in Figure I and located in a building or fabricated total enclosure as shown in Figure II (i.e. with enclosed sides and top). The enclosure shall be such that there are no constant or intermittent air flows within it that cause fluctuations in the stack velocity and/or disruptions of air flow patterns within the test chamber containing the reference grill.

WARNING: If stack is vented into the building enclosure, caution must be taken to avoid carbon monoxide poisoning and the reduction of oxygen.

Equivalent equipment will be acceptable for the purposes of Section 4.1 and 4.2 below. All such equipment and supporting documents should be submitted to the District at least 30 days prior to conducting tests for equivalency approval consideration. Written approval from the Executive Officer is required prior to compliance certification testing conducted on an alternate or modified test structure.

4.1 TEST STRUCTURE COMPONENTS

- 4.1.1 **Test Chamber** - Standard large, prefabricated fireplace manufactured by Marco, Model No. C41CF, with flue damper removed; or a fabricated structure with the same dimensions as shown in Figure I. Spacers are required at the rear of the test chamber to ensure a constant 2 in. distance between the reference grill and the rear wall of the test chamber.
- 4.1.2 **Test Stack** - 10" diameter galvanized steel ducting with velocity traverse port holes located approximately eight diameters downstream from the stack outlet of the fireplace chamber and sampling ports located approximately two-and-a-half diameters downstream of the velocity traverse ports.
- 4.1.3 **Fan** - 10" diameter axial fan (duct fan) capable of maintaining an air velocity of 450 ± 30 fpm and located in the stack approximately three diameters downstream of the sampling ports.
- 4.1.4 **Test Stack Insulation** - The stack shall be insulated with fiberglass blanket insulation (or equivalent) with a minimum R-value of 6.4, that totally surrounds the stack from the top of the fireplace to the level of the blower which minimizes temperature gradients in the stack and prevent hydrocarbons from condensing on the stack wall.

- 4.1.5 **Stack Mounts** - Supports for fixing in position the Kurz digital air velocity meter or pitot tube for measuring reference point readings and the Century OVA probe/ meter.
- 4.1.6 **Blower Speed Control** - A rheostat for controlling voltage to the fan.

4.2 TEST EQUIPMENT

- 4.2.1 **Continuous Recording Device** - A YEW model 4088 dot matrix, roster scanning chart recorder or equivalent, is used to continuously (6 second cycle) to record temperatures, velocity, and OVA monitor output signals.

The recording may be done manually, recording temperature using a digital potentiometer (20 second intervals), reference point velocity with a Pitot tube (20 second intervals), and OVA readings with the analyzer's meter (10 second intervals). See Appendix C for forms.

- 4.2.2 **Grill Temperature Probe** - A type "K" thermocouple silver soldered to a 3" square brass plate 0.033" thick painted flat black using high temperature (> 700°F) paint; set on an adjustable stand to maintain 4.5 inches above the maximum height of the briquette pile and made such that it can be removed and replaced within the chamber.

- 4.2.3 **Stack Temperature Probe** - The Kurz digital air velocity meter or a type "K" thermocouple can be used.
- 4.2.4 **Stack Velocity Measurement Device** - The velocity in feet per minute for the reference point using a Kurz digital air velocity meter or equivalent to District Method 1.2.
- 4.2.5 **Organic Vapor Analyzer (OVA)** - Century Model 128 OVA (or equivalent) with response in ppm (ranges 0 to 10 ppm, 0 to 100 ppm, 0 to 1000 ppm).
- 4.2.6 **Temperature and Humidity Monitor** - A chart recorder type with humidity accuracy of $\pm 3\%$ from 15 to 85%.
- 4.2.7 **Wind Speed and Direction Monitor** - A wind speed and direction device meeting a tolerance of $\pm 10\%$.
- 4.2.8 **Analytical Balance** - An electronic scale with a resolution of ± 2 grams.
- 4.2.9 **Charcoal Stacking Ring** - Rigid metal cylinder 8.5 inches in diameter with indicators to determine that the pile of briquettes does not exceed 5 inches in height.
- 4.2.10 **Camera** - To document ignition condition of charcoal at the end of each start.
- 4.2.11 **Particulate Filter** - Nupro inline filter, Catalog Number SS-4FW-2 with 1/4" swagelok inlet and outlet or equivalent.

4.3 REFERENCE MATERIALS

The following are considered as reference with no equivalent:

- 4.3.1 **Reference Barbecue Grill** - The charcoal must be ignited in a Weber "Go Anywhere" barbecue grill (Model Number #121001), 15.5" X 9.5" X 5.0", with the grate 1.75" above the bottom of the grill. Grill to be set on its bottom when placed in test chamber and all grill air vents must be in full open position.
- 4.3.2 **Reference Electric Probe** - A Christen 600 watt, Item #78-821 electric probe will be used for electric probe ignition tests.
- 4.3.3 **Reference Charcoal - Untreated Charcoal** - The independent testing laboratory conducting the testing is to purchase "off the shelf" untreated charcoal from a retail outlet. Charcoal is not to be provided by the manufacturer of the ignition source to be tested or by the Charcoal manufacturer. The charcoal to be used is Kingsford "Original Charcoal Briquets" manufactured at the Springfield plant and made within the last twelve months (the first character of the lot number will be "S"; the second character identifies the last digit in the year, and the next three characters identify the sequential calendar day of the year). All untreated charcoal used in

the certification testing of a single ignition source is to come from the same lot as indicated by the number printed on the bag.

4.3.4 **Reference Charcoal - Treated or Impregnated Charcoal** - The manufacturer will provide to the independent test laboratory conducting the tests two forms of charcoal from the same lot.

a) One form for the reference VOC emissions, will be untreated and not impregnated. Testing by electric probe will be performed on a 2.0 pound amount.

b) For experimental (not commercially available), the other form will be impregnated or treated barbecue charcoal that are ignited either outside of package or ignited by the package. If commercially available, the independent testing laboratory conducting the test is to purchase "off the shelf" from a retail outlet.

5. SAMPLING AND ANALYTICAL METHODS

5.1 GAS VOLUMETRIC FLOW RATE

Conduct a full velocity traverse using a Kurz digital air velocity meter (Figure III) or use District Source Test Method 1.2. Continuously record a velocity reference point reading during each test run using chart recorder or once every 20 seconds if using Method 1.2.

Calculate the volumetric flow rate using the gas velocity, moisture content, and the stack cross-sectional area. For the purposes of this protocol, the static pressure is assumed to be atmospheric, the molar density correction factor in the stack to be 1.0, and the moisture content to be 2 percent.

5.2 INTEGRATED VOC SAMPLE

Collect integrated VOC gas samples at the sampling port in the exhaust stack using a District Method 25.1 TCA sampling apparatus consisting of two evacuated nine-liter tanks, each equipped with flow controllers, condensate traps, vacuum gauges, and probes (See Figure IV).

Use District Methods 10.1, 25.1 (or equivalent) for analysis. Carbon monoxide, carbon dioxide, methane, and

non-methane organic carbon analyzed by the Total Combustion Analysis (TCA) and Total Combustion Analysis/Flame Ionization Detector (TCA/FID) Methods. Oxygen content determined by gas chromatography using a thermal conductivity detector (TCD). Clean particulate filters between use by heating to 1400°F while using compressed air as a carrier for cleaning and purging.

5.3 CONTINUOUS ORGANIC VAPOR ANALYZER (OVA)

A Century Organic Vapor Analyzer Model 128 which uses a continuous Flame Ionization Detector (FID) shall be used for each test run to measure the real time organic concentration of the exhaust as methane. Record the OVA response in ppm continuously during the sampling period using a chart recorder or once every 10 seconds using the form found in Appendix C.

The VOC analyzer is to be operated as prescribed in the manufacturer's directions unless otherwise noted in this protocol.

6. TESTING PROCEDURE

6.1 PRETEST PROCEDURE

6.1.1 Ignition Methods--Untreated Charcoal

Before each test run, remove charcoal from a sealed bag that has been stored for at least 72 hours in a humidity and temperature controlled room (which satisfies the requirements of Section 2 of this protocol "Meteorological and Environmental Criteria") and weigh out two pounds of charcoal briquettes (to the nearest whole briquette over 2 pounds) of uniform shape with no broken pieces using an analytical balance. Reseal the bag. Charcoal must be ignited within 10 minutes after removal from bag. A sealed bag of charcoal cannot be stored at the test site for greater than 45 minutes. It must be returned to a humidity and temperature controlled room for 72 hours. The ignition method must be purchased, stored, weighed, and handled the same as the barbecue charcoal

- a) For the reference VOC emission tests using an electric probe, place a single layer of charcoal, slightly larger than the area/circle of the electric probe heating element, onto the grate. Place the heating element on top of this first

layer and cover the heating element with the remaining charcoal briquettes.

- b) For the ignition VOC emissions tests, arrange the briquettes on the barbecue grate in the manner specified by the ignition manufacturer's directions. If these manufacturer's directions do not specify a stacking arrangement for the briquettes, randomly stack the briquettes in a pile with a bottom diameter of 8.5 inches and a maximum height of 5 inches.

6.1.2 Ignition Methods--Treated or Impregnated Charcoal

Store, handle, weigh and stack barbecue charcoal, that is designed to be lit without the packaging, the same as above in Section 6.1.1.

For those products which require both the package and charcoal be lit, weigh the whole package--do not remove charcoal. Weigh an empty package (not the same one to be used during the test). Subtract the package weight from the overall weight of the package and charcoal. The full package and empty package must be stored, handled, and weighed the same as above in Section 6.1.1. If the difference (the charcoal weight) is between 1.5 to 3.0 pounds, the test may proceed and the emissions measured (E) in Equation (4) of Section 7.7 adjusts to a 2.0 pound

charge. Place packaged barbecue charcoal on the grate in the manner specified by manufacturer's directions.

- 6.1.3 Initial meteorological and environmental criteria in Section 2 must be complied with. Use atmospheric and environmental data sheet in Appendix C to record values.
- 6.1.4 The stack velocity must be set before each day of testing at 450 ± 30 fpm by performing a velocity traverse (refer to Section 5.1). The velocity will be attained by adjusting the axial fan speed using a rheostat.
- 6.1.5 The fireplace shall be conditioned at the start of each day before sampling tests by using a grill ignited by the electric probe. If a time period of over 60 minutes between sampling test runs occur, the conditioning step must be repeated.
- 6.1.6 Before each test run, leak check the Century OVA by blocking the flow to the probe. Allow the instrument to warm-up for the duration specified by the manufacturer's directions. Select the 0 to 100 ppm range. Check the battery level and hydrogen pressure. Zero with hydrocarbon-free air (< 0.1 ppm hydrocarbons as methane), span with 70 ppm (or select a value between 60 to 80 ppm) methane in ultra pure air. Zero and span another instrument selection range if needed for test purposes. Use the forms in Appendix C to record the above operations.

- 6.1.7 Before testing program begins, establish a point of average concentration of organics in the stack by using an OVA and a grill with charcoal ignited by the electric probe 40 minutes after initial release of emissions. Record data on OVA traverse sheet in Appendix C.
- 6.1.8 Prepare Method 25.1 TCA sampling equipment and leak checks as described in Section 2 of the District Source Testing Manual (Method 25.1). Fit the probes with nozzles housing 2 micron particulate filters. Insert the probes and nozzles into the sampling port to draw a sample of the exhaust gas from the point of average organic concentration as determined from OVA sample traverse described in Section 6.1.4. Also, position the nozzles such that they point downstream in the stack. Obtain the samples concurrently and continuously over the test run.
- 6.1.9 Insert the OVA probe into the sampling port to draw a sample of the exhaust gas from the point of average organic concentration as determined from OVA sample traverse described in Section 6.1.7.

6.2 TEST PROCEDURE

The labeled directions defined in Section 3 shall be followed throughout the course of the certification testing. In cases where the directions are incompatible with this protocol, circumvent the intent of this protocol, or are unclear (subject to different

interpretations) and inadequate, the Executive Officer must be informed in writing of the nature of the conflict, as well as the proposed resolution, prior to commencing testing.

When an ignition product does not fall within the testing guidelines of this protocol, the protocol may only be modified upon written approval of the Executive Officer.

- 6.2.1 Place the bottom of the barbecue on the floor of the fireplace, 2" from the rear wall. Ignite charcoal as specified by manufacturer's labeled directions.
- 6.2.2 For electric probe ignition, carefully remove probe without disturbing charcoal after 10 minutes of operation.
- 6.2.3 For fluid ignition, simultaneously match light fluid on charcoal and fluid that has fallen to the bottom of the grill.
- 6.2.4 Place the grill temperature probe 4.5" above the top of the charcoal immediately after the ignition method flame goes out, or before, if ignition method does not flame.
- 6.2.5 Conduct at least six test runs for both the electric probe ignition and for the ignition method being evaluated. Alternate these ignition methods for all twelve runs. All runs must be conducted over 3 consecutive days or less. VOC sampling (using District Source Test Method 25.1) and OVA sampling begins for each test run when the ignition

method and/or materials start to generate/release organics (this will be the time of pouring for lighter fluids and the time of ignition for most other ignition sources).

Option: Because the manufacturer of treated or impregnated charcoal supplies both the ignition method and barbecue charcoal, they may apply the 0.02 lb/start of VOC emission limit as an absolute value without an adjustment for the VOC emissions from an electric probe.

6.2.6 Sampling ends for each test run when all the following conditions are met: 1) the temperature 4.5 in. above the maximum height of the briquette pile, using the grill temperature probe described in Section 4.2.2, is at least 200°F, 2) the Century OVA is reading below 30 ppm for at least 2 minutes, 3) the test sampling has continued for 25 minutes (but not more), and 4) the charcoal surface is 70% covered with ash (to be documented with photograph on top and 60° above the horizon).

6.2.7 During the sampling test runs, temperatures (excluding ambient) and OVA readings shall be recorded and shall comply with the requirements in Section 2. Humidity, wind speed, and ambient temperature readings shall be monitored and shall comply with the requirements in Section 2.

6.2.8 Collect one blank sample and one ambient air sample during one run of each day.

6.3 POST RUN PROCEDURE

- 6.3.1 Record temperatures (including ambient), humidity, wind speed, and OVA reading.
- 6.3.2 Record the drift using zero and span gases. Leak check and span OVA as described in Section 6.1.3 for the next run.
- 6.3.3 Leak check and disassemble Method 25.1 sampling equipment as described in Section 2 of the Source Testing Manual in Method 25.1.
- 6.3.4 Thoroughly clean grill surfaces of all residue before conducting next ignition run.

7. CALCULATIONS

Calculations should be carried out to at least one significant digit beyond that of the acquired data, and then should be rounded off after final calculation to two significant digits for each run. All rounding off of numbers should be in accordance with the ASTM E380-82 procedures. Use the calculation sheets in Appendix B.

- 7.1 Calculate the average stack reference point temperature during sampling (t_{sr}).
- 7.2 Calculate the average measured velocities (in feet per minute): Traverse (u_t), traverse reference point (u_{tr}), and reference point during sampling (u_{sr}).
- 7.3 Calculate the corrected average sampling velocity (u_s) by applying Equation (1):

$$u_s = u_{sr} \frac{u_t}{u_{tr}} \quad (1)$$

- 7.4 Calculate the average flow rate (Q_s) in cfm by applying Equation (2):

$$Q_s = u_s A \quad (2)$$

Where

$$A = \text{Duct cross-sectional area (ft}^2\text{)}$$

- 7.5 Correct the flow rate to dry standard conditions (Q_{ds}) by applying Equation (3). Assume the static pressure to be atmospheric and the molar density correction factor to be 1.0.

$$Q_{ds} = \frac{520}{(460 + t_{sr})} (1-H) Q_s \quad (3)$$

where

$$\begin{aligned} H &= \text{Percent moisture} - 100 \\ &= 0.02 \end{aligned}$$

- 7.6 Calculate the average total gaseous non-methane organic carbon for each duplicate sample run analyzed.
- 7.7 Calculate the pounds of volatile organic compounds as CH_2 emitted per start (normalized to two pounds of charcoal) for each run using Equation (4):

$$E = \frac{A}{B} * \frac{C}{10^6} * D * d * \frac{2 \text{ lb}}{M} * Q_{ds} \quad (4)$$

where

$$E = \text{Emissions of VOC per start for each test run} \\ (\text{lb VOC/start})$$

$$\begin{aligned} A &= \text{Hydrocarbon molecular weight} \\ &= 14.0268 \text{ lb/lbmol} \end{aligned}$$

$$\begin{aligned} B &= \text{Carbon number} \\ &= 1 \end{aligned}$$

C = Average concentration for each duplicate run of TGNMOC as CO₂ (ppm, from lab analysis sheet)

D = Sampling duration
= 25 minutes

d = Molar density of gas at standard conditions
= 2.6353×10^{-3} lbmol/ft³

M = Mass of charge (lb)

7.8 Calculate the average VOC emissions for each ignition method tested. Identify and discard statistical outliers as prescribed on the Statistical Analysis form in Appendix B. Note a minimum of five valid results are required for a determination. This procedure for eliminating an outlier may only be performed once for each ignition method.

7.9 Using equation (5), calculate the resultant VOC emissions per start (E_r) and determine if it is less than or equal to the 0.02 VOC pound per start emission limit.

$$E_r = e_i - e_{ep} + E_b \quad (5)$$

where

e_i = Average emissions of VOC per start from the ignition method being evaluated (lb VOC/start)

e_{ep} = Average reference VOC emissions per start from the ignition by electric probe (lb VOC/start)

E_b = Standard baseline VOC emissions per start
from the ignition by electric probe
= 0.008 lb VOC/start

8. REPORT

A formal report shall be submitted in the format outlined in Chapter II of the District Source Test Manual. Where deviations occur between the manual and this protocol, this protocol should be followed.

All compliance certification reports shall include the following:

1. Real time temperature and Century VOC readings from continuous chart recorder and/or manual reading of temperatures and Century VOC reading using forms similar to those in Appendix C.
2. Describe QA/QC procedures followed for all measuring equipment and submit calibration test data.
3. Describe QA/QC procedures followed for all sampling and analysis equipment and submit calibration test data.
4. Time and quantity of blanks and ambient air samples.
5. Chain of Custody for samples.
6. Labeled directions.
7. Field notes and data sheets.
8. Calculation/Averaging sheets/printouts.
9. Sample (in its normal package from the same lot) of barbecue charcoal and ignition method used for testing.
10. Formulation of ignition method tested (indicate if the information is to be handled confidentially).
11. Photographs documenting charcoal surface ash coverage.

9. QUALITY ASSURANCE/ QUALITY CONTROL REQUIREMENTS

Follow the QA/QC guidelines in the District's Source Test Manual (DSTM). Follow the methods and procedures outlined in that manual unless otherwise described in this protocol.

- 9.1 A blank sample for VOC shall be performed once each day, during the start period of one of the ignition methods, using Method 25.1 apparatus.
- 9.2 An ambient air sample for VOC shall be taken once each day, during the start period of one of the ignition methods, using Method 25.1 sampling apparatus with Nupro 2 micron filters.
- 9.3 Traceability certificates shall be provided for all calibration gases used for OVA, and Method 10.1 and 25.1 analysis.
- 9.4 Grill temperature probe shall be calibrated in a muffle furnace as described in Chapter III Section 5 of the District Source Test Manual.
- 9.5 Supply documentation for place of purchase (or origin if experimental) and chain of custody for ignition method tested. Documentation to be included for both treated and impregnated charcoal.
- 9.6 Supply documentation for place of purchase and chain of custody for untreated charcoal.

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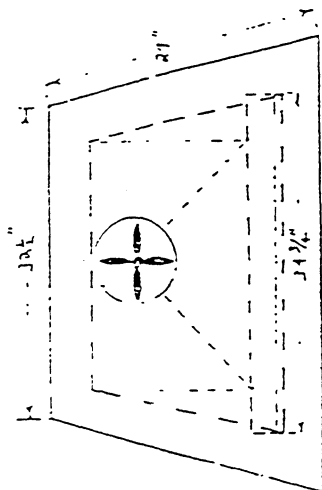
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APPENDIX A FIGURES AND PHOTOGRAPHS

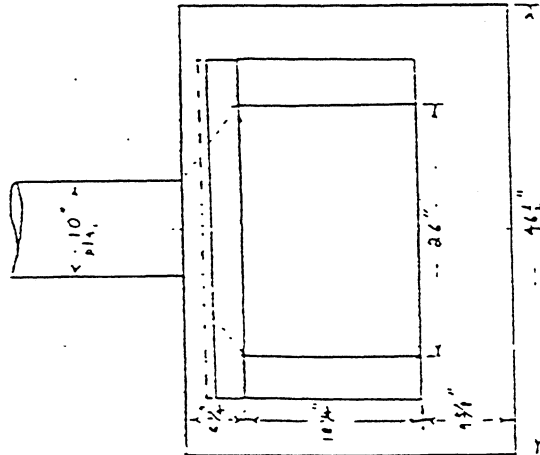
The following are provided to assist in the construction and testing phases.

- a) Figure I
- b) Figure II
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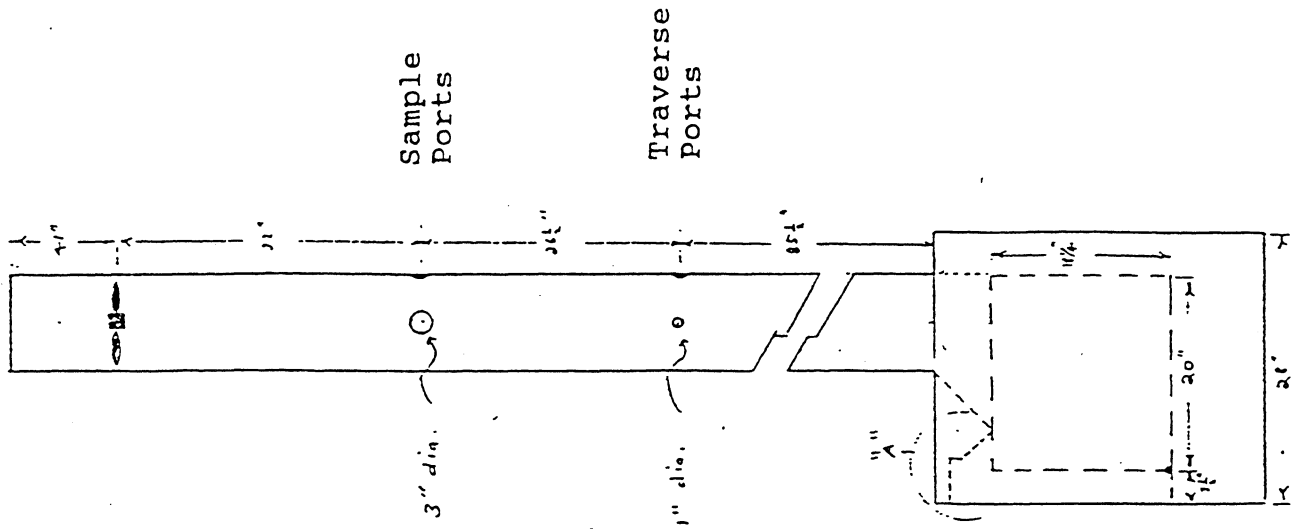
RULE 1174 IGNITION METHOD COMPLIANCE
CERTIFICATION PROTOCOL



TOP



FRONT



SIDE

scale 1:20

RULE 1174 IGNITION METHOD COMPLIANCE
CERTIFICATION PROTOCOL

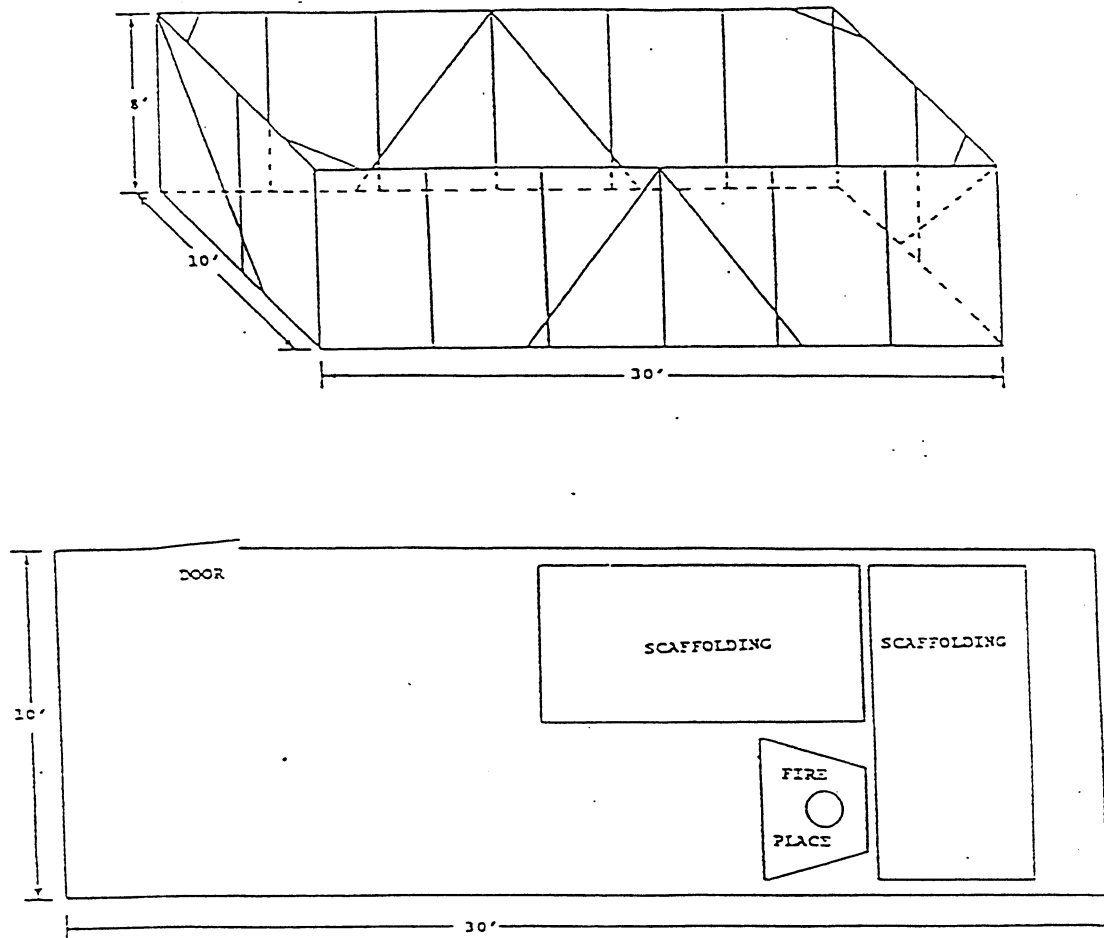


FIGURE II
SUGGESTED ENCLOSURE DESIGN

RULE 1174 IGNITION METHOD COMPLIANCE
CERTIFICATION PROTOCOL

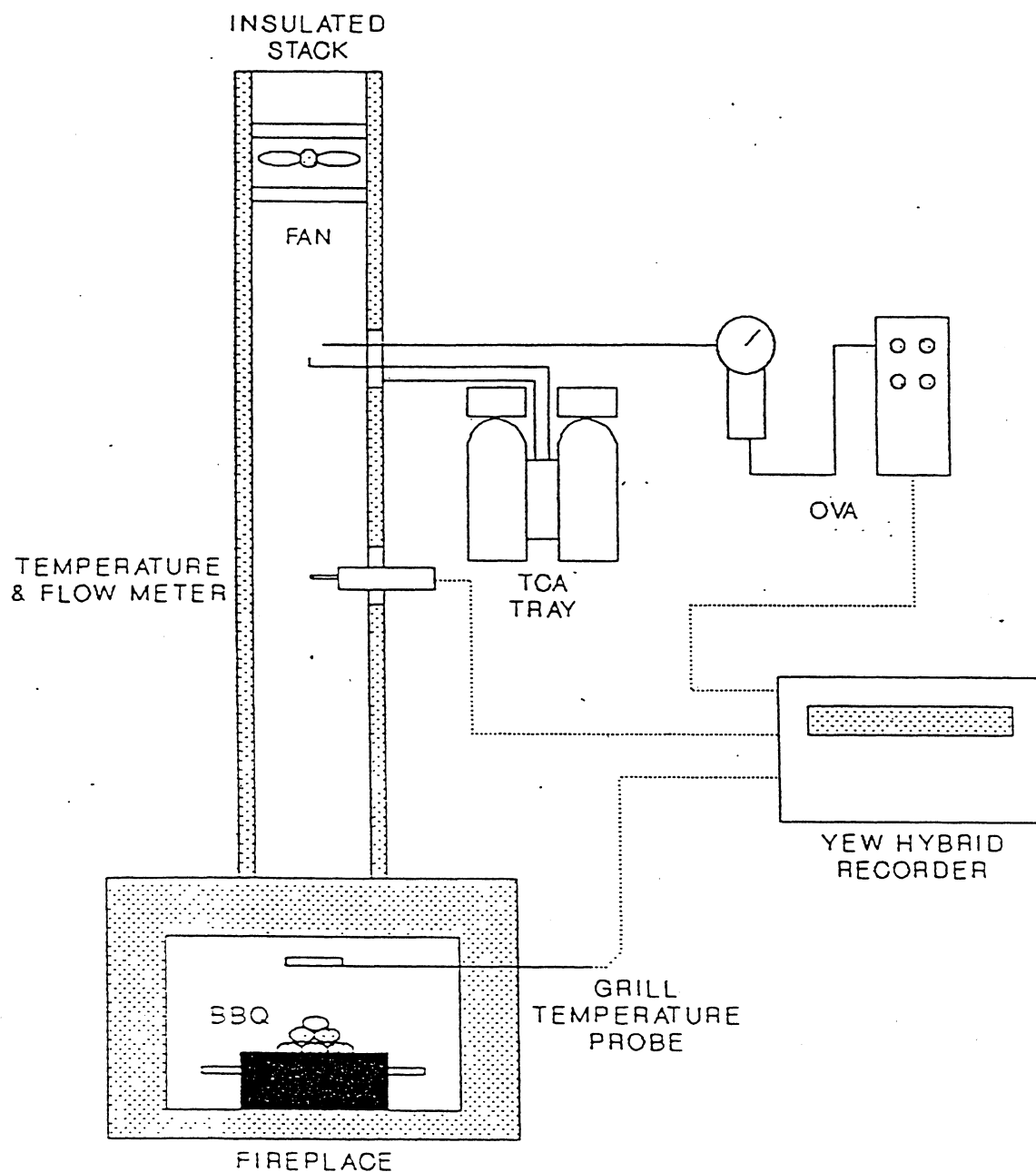
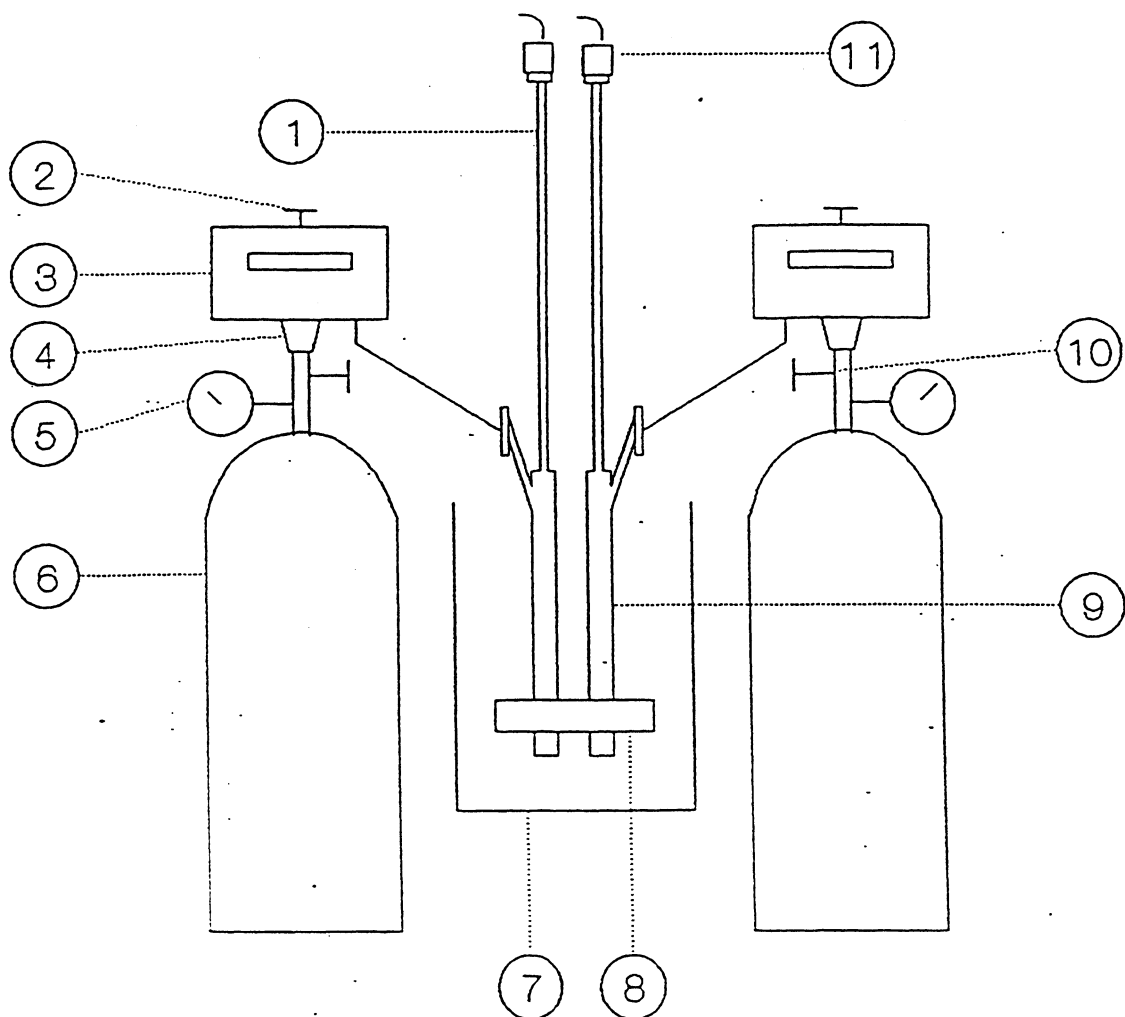


FIGURE III
SAMPLING APPARATUS SET-UP WITH CHART RECORDER

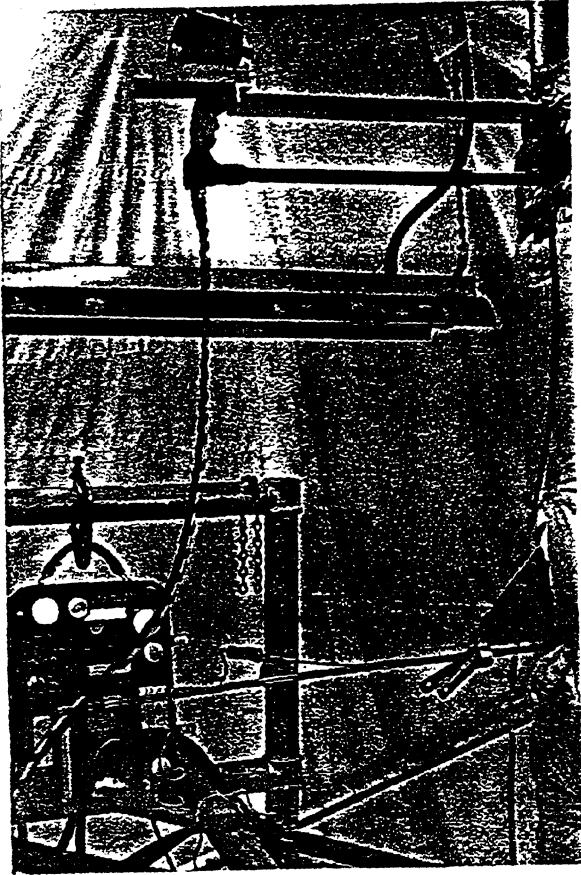
RULE 1174 IGNITION METHOD COMPLIANCE CERTIFICATION PROTOCOL



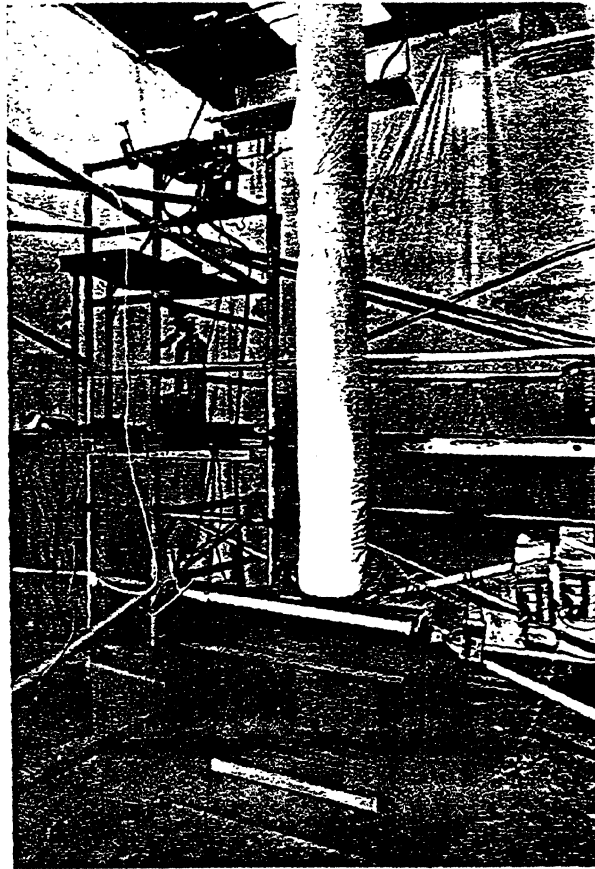
- | | |
|---|-----------------------------------|
| 1. SAMPLING PROBE | 6. EVACUATED TANK |
| 2. FLOW RATE CONTROL VALVE | 7. CONDENSATE TRAP CONTAINER |
| 3. MINIHILIC DIFFERENTIAL
PRESSURE GAUGE | 8. HEAT SINK TRAP |
| 4. VACUUM REGULATOR | 9. CONDENSATE TRAP |
| 5. VACUUM GAUGE | 10. SAMPLE FLOW VALVE |
| | 11. TWO MICRON PARTICULATE FILTER |

FIGURE IV
SAMPLE APPARATUS FOR ORGANICS

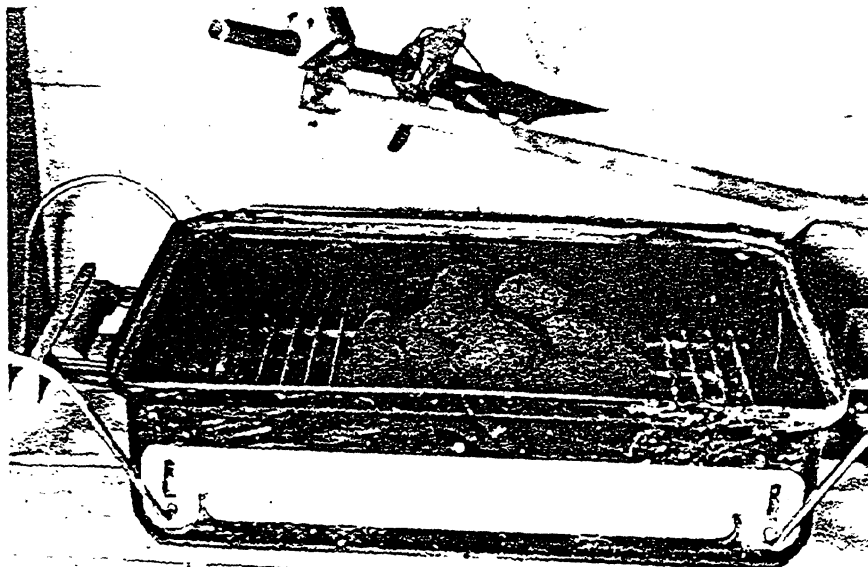
Photographs
Charcoal Ignition Test Structure



Stack Mounts For
OVA and Pitot Tube



Fireplace Structure



Grill With Temperature Probe

APPENDIX B CALCULATION SHEETS

The following sheets (attached) must be used in performing calculations:

- a) Mass Emissions
- b) Statistical Analysis
- c) Resultant Emissions

Test No: _____

MASS EMISSIONS
CALCULATION SHEET
(CHARCOAL IGNITION)

Date: _____

Charcoal Ignition Method: _____

Run No. _____

- A. Average traverse velocity (u_t)..... _____ fpm
B. Average traverse reference point velocity (u_{tr})..... _____ fpm
C. Average reference point velocity
during sampling (u_{sr})..... _____ fpm
D. Average reference point temperature
during sampling (t_{sr})..... _____ °F
E. Flue correction factor (A/B) = _____
F. Percent moisture (assume 2%)..... .02
G. Corrected sampling velocity (C * E) = _____ fpm
H. Stack cross sectional area = _____ ft²
I. Flow rate (Q_s) = (G * H) = _____ cfm
J. Flow rate (dry standard) = (1 - F) * I * 520/(460 + D) = _____ scfm
K. Hydrocarbon molecular weight..... 14.027
L. Carbon number..... 1
M. Average concentration of TGNMOC as CO₂
(from laboratory analysis)..... _____ ppm
N. Sampling duration..... _____ min
O. Molar density of gas
at standard conditions..... 2.635×10^{-3} lbmol/ft³
P. Mass of charge..... _____ lb
Q. Mass emission of VOC as CH₂ per start
[K * M * N * O * J * (2 lb)] / [L * (10⁶) * P] = _____ lb/start

Test No: _____

STATISTICAL ANALYSIS
CALCULATION SHEET
(CHARCOAL IGNITION)

Date: _____

Charcoal Ignition Method: _____

t-test for Excluding Statistical Outliers

run # lb/start (E)

(n)

1

2

3

4

5

6

$$(1) \text{ Avg} = [\Sigma (\text{lb/start})]/n$$

$$\text{Avg} = \frac{\text{lb/start}}{\text{_____}}$$

$$(2) \text{ std dev} = \left[\left\{ \frac{\sum_{i=1}^n (E_i - \text{Avg})^2}{n-1} \right\} \right]^{1/2}$$

where n = number of data points

$$\text{std dev} = \frac{\text{_____}}{\text{_____}}$$

$$(3) \text{ Ratio} = \text{std dev}/\text{avg}$$

$$\text{Ratio} = \frac{\text{_____}}{\text{_____}}$$

If Ratio \leq 0.3, statistical outliers may not be excluded; proceed to Equation (6)

If Ratio $>$ 0.3, proceed to Equation (4)

$$(4) \text{ Upper Acceptable Limit} = \text{Avg} + [t \cdot (\text{std dev}) \cdot (n)^{-1/2}]$$

$$(5) \text{ Lower Acceptable Limit} = \text{Avg} - [t \cdot (\text{std dev}) \cdot (n)^{-1/2}]$$

where t = 2.571 for n = 6 data points at a 95% confidence level.
(for values of t corresponding to more than 6 data points,
consult a t-distribution chart).

$$(4) \text{ Upper Acceptable Limit} = \text{_____} + [\text{_____} \cdot (\text{_____}) \cdot (\text{_____})^{-1/2}]$$

$$= \text{_____ lb/start}$$

$$(5) \text{ Lower Acceptable Limit} = \text{_____} - [\text{_____} \cdot (\text{_____}) \cdot (\text{_____})^{-1/2}]$$

$$= \text{_____ lb/start}$$

Values of E that do not fall within this range must be discarded as statistical outliers. All values of E that fall within this range must be included in calculating the corrected average emissions (e_e) or the corrected average baseline emissions (e_{ep}). In addition, a minimum number of five (5) data points are required. If, after outlier elimination, there are less than five valid data points, the series of tests must be conducted again.

Only one (1) t-test calculation may be used to exclude statistical outliers.

Test No: _____

CHARCOAL IGNITION
CALCULATION SHEET
RESULTANT EMISSIONS

Date _____

Charcoal Ignition Method: _____

Baseline Emissions

(6) e_{ep} = Avg emissions of VOC per start by electric probe,
excluding statistical outliers (where applicable)

e_{ep} = _____ lb/start

Corrected Average Emissions from Tested Product

(7) e_e = Avg emissions of VOC per start by tested ignition
method, excluding statistical outliers (where
applicable)

e_e = _____ lb/start

Resultant Emissions for Rule 1174 Compliance Determination

(8) $E_R = e_e - e_{ep} + 0.008$

where

E_R = resultant average emissions of VOC per start
for Rule 1174 compliance determination (lb/start)

0.008 = standard baseline emissions of VOC per start from
ignition by electric probe (lb/start)

$E_R =$ _____ - _____ + 0.008

$E_R =$ _____ lb/start

APPENDIX C CHARCOAL IGNITION DATA SHEETS

The following sheets (attached) may be used in performing tests and summarizing results.

- a) Gas Velocity Data
- b) OVA Traverse Sheet - Stratification Check
- c) OVA Data
- d) TCA Data
- e) Reference Point Velocity, Temperature
- f) TCA Data Summary
- g) Meteorological and Ambient Data

CHARCOAL IGNITION DATA SHEET
GAS VELOCITY DATA

Test No. _____

Date _____

Pre-Test Velocity Leak Check _____

Post-Test Velocity Leak Check _____
@end of day _____

Time: _____

Trav. Pt	1	2	RPT	3	4	5	6	RPT	7	8.
Vel. Head "H ₂ O										
Temp. °F										
Calc. Vel. fpm										
Kurz Vel. fpm										
Vel. Head "H ₂ O										
Temp. °F										
Calc. Vel. fpm										
Kurz Vel. fpm										
Vel. Head "H ₂ O										
Temp. °F										
Calc. Vel. fpm										
Kurz Vel. fpm										
Vel. Head "H ₂ O										
Temp. °F										
Calc. Vel. fpm										
Kurz Vel. fpm										

Avg. Calculated Velocity fpm
Pts. 1-8 (excluding Ref. Pts.) _____

Avg. Calculated Velocity fpm
Ref. Pts. _____

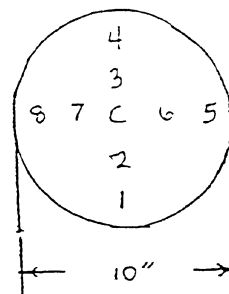
Static Pressure in Stack _____ "HgA (+/- _____ "H₂O)

Barometric Pressure _____ "HgA Pitot Factor _____

Recorded By _____ Calculated by _____

Calibration Data

Magnehelic Number _____ (Cal: _____)
Pitot Tube Number _____ (Cal: _____)
Potentiometer No. _____ (Cal: _____)
Thermocouple No. _____ (Cal: _____)
Kurz Meter Number _____ (Cal: _____)
Potentiometer No. _____ (Cal: _____)
Brass Plate T/C No. _____ (Cal: _____)



Test No: _____ CHARCOAL IGNITION DATA SHEET
 OVA TRAVERSE SHEET--STRATIFICATION CHECK

Date: _____

Pre-Test Leak Check: _____

Post-Test Leak Check: _____

Calculated by: _____

Time	Trav. Point	OVA (ppm)	OVA (ppm)	OVA (ppm)
	1			
	2			
	Center			
	3			
	4			
	5			
	6			
	Center			
	7			
	8			

A. Total Average of Points 1, 2, 3, 4, 5, 6, 7 and 8: _____ ppm

B. Total Average of Center Points: _____ ppm

C. Percent difference between A and B: $[(A - B)/A] \times 100 =$ _____ %

If C is less than $\pm 10\%$, then the sampling point shall be the center point.

If C is greater than $\pm 10\%$, select another point with an average OVA reading $\pm 10\%$ of the average concentration and use that point as the sampling point. [Point Used: _____ Percent Difference: _____]

Run # _____

OVA DATA

OVA Make _____ Model No. _____ S.N. _____

Charcoal Ignition Method _____

Start Time: _____ Cylinder Value: Span _____ ppm Zero _____ ppm
 Finish Time: _____ Pre-Test Value: Span _____ Zero _____ Leak _____
 Background: _____ ppm Post-Test Value: Span _____ Zero _____ Leak _____
 Recorded By: _____ Hydrogen Pressure Check (> 500 psi) _____

Time (min,sec)	OVA (ppm)	Time (min,sec)	OVA (ppm)	Time (min,sec)	OVA (ppm)
0 10	_____	8 30	_____	16 50	_____
0 20	_____	8 40	_____	17 00	_____
0 30	_____	8 50	_____	17 10	_____
0 40	_____	9 00	_____	17 20	_____
0 50	_____	9 10	_____	17 30	_____
1 00	_____	9 20	_____	17 40	_____
1 10	_____	9 30	_____	17 50	_____
1 20	_____	9 40	_____	18 00	_____
1 30	_____	9 50	_____	18 10	_____
1 40	_____	10 00	_____	18 20	_____
1 50	_____	10 10	_____	18 30	_____
2 00	_____	10 20	_____	18 40	_____
2 10	_____	10 30	_____	18 50	_____
2 20	_____	10 40	_____	19 00	_____
2 30	_____	10 50	_____	19 10	_____
2 40	_____	11 00	_____	19 20	_____
2 50	_____	11 10	_____	19 30	_____
3 00	_____	11 20	_____	19 40	_____
3 10	_____	11 30	_____	19 50	_____
3 20	_____	11 40	_____	20 00	_____
3 30	_____	11 50	_____	20 10	_____
3 40	_____	12 00	_____	20 20	_____
3 50	_____	12 10	_____	20 30	_____
4 00	_____	12 20	_____	20 40	_____
4 10	_____	12 30	_____	20 50	_____
4 20	_____	12 40	_____	21 00	_____
4 30	_____	12 50	_____	21 10	_____
4 40	_____	13 00	_____	21 20	_____
4 50	_____	13 10	_____	21 30	_____
5 00	_____	13 20	_____	21 40	_____
5 10	_____	13 30	_____	21 50	_____
5 20	_____	13 40	_____	22 00	_____
5 30	_____	13 50	_____	22 10	_____
5 40	_____	14 00	_____	22 20	_____
5 50	_____	14 10	_____	22 30	_____
6 00	_____	14 20	_____	22 40	_____
6 10	_____	14 30	_____	22 50	_____
6 20	_____	14 40	_____	23 00	_____
6 30	_____	14 50	_____	23 10	_____
6 40	_____	15 00	_____	23 20	_____
6 50	_____	15 10	_____	23 30	_____
7 00	_____	15 20	_____	23 40	_____
7 10	_____	15 30	_____	23 50	_____
7 20	_____	15 40	_____	24 00	_____
7 30	_____	15 50	_____	24 10	_____
7 40	_____	16 00	_____	24 20	_____
7 50	_____	16 10	_____	24 30	_____
8 00	_____	16 20	_____	24 40	_____
8 10	_____	16 30	_____	24 50	_____
8 20	_____	16 40	_____	25 00	_____

Test No: _____

CHARCOAL IGNITION DATA SHEET

Date: _____

TCA DATA

RUN #. _____

Charcoal Ignition Method _____

Pre-Test Leak Rate: Gauge _____

Delta P _____

Post-Test Leak Rate: Gauge _____

Delta P _____

Barometric Pressure _____ "HgA

Recorded By: _____

	Flask # _____ Trap # _____ Cont. # _____			Flask # _____ Trap # _____ Cont. # _____		
Time (min)	Delta P	Vacuum	Comments	Delta P	Vacuum	Comments
Start						
+2.5						
+5.0						
+7.5						
+10.0						
+12.5						
+15.0						
+17.5						
+20.0						
+22.5						
End +25.0						

Test No: _____

CHARCOAL IGNITION DATA SHEET
REFERENCE POINT VELOCITY, TEMPERATURES
RUN # _____

Date: _____

Charcoal Ignition Method _____

Time (min,sec)	Vel. Head ("H ₂ O)	Stack Temp. (°F)	Temp. 4.5" above briquettes (°F)	Velocity (as measured or calculated) (ft/min)
0 20				
0 40				
1 00				
1 20				
1 40				
2 00				
2 20				
2 40				
3 00				
3 20				
3 40				
4 00				
4 20				
4 40				
5 00				
5 20				
5 40				
6 00				
6 20				
6 40				
7 00				
7 20				
7 40				
8 00				
8 20				
8 40				
9 00				
9 20				
9 40				
10 00				
10 20				
10 40				
11 00				
11 20				
11 40				
12 00				
12 20				
12 40				
13 00				
13 20				
13 40				
14 00				

Test No: _____

CHARCOAL IGNITION DATA SHEET
REFERENCE POINT VELOCITY, TEMPERATURES
RUN # _____

Date: _____

(continued)

Time (min, sec)	Vel. Head ("H ₂ O)	Stack Temp. (°F)	Temp. 4.5" above briquettes (°F)	Velocity (as measured or calculated) (ft/min)
14 20				
14 40				
15 00				
15 20				
15 40				
16 00				
16 20				
16 40				
17 00				
17 20				
17 40				
18 00				
18 20				
18 40				
19 00				
19 20				
19 40				
20 00				
20 20				
20 40				
21 00				
21 20				
21 40				
22 00				
22 20				
22 40				
23 00				
23 20				
23 40				
24 00				
24 20				
24 40				
25 00				
Averages				

Recorded by: _____

Calculated by: _____

Calibration Data:

Manometer No. _____ (Cal Date: _____)
 Pitot Tube No. _____ (Cal Date: _____)
 Pitot Factor _____
 Potentiometer No. _____ (Cal Date: _____)
 Kurz Meter No. _____ (Cal Date: _____)
 Thermocouple No. _____
 (Stack) _____ (Cal Date: _____)
 (Brass Plates) _____ (Cal Date: _____)

TEST NO: _____

CHARCOAL IGNITION DATA SHEET
TCA DATA SUMMARY

DATE: _____

Ignition Method: _____

Calculated By: _____

	CO ₂	CO	CH ₄	Fore-Flush	Back-Flush	Trap	Total Organix	Total w/o CH ₄	%O ₂
Run #1									
Tnk#									
Tnk#									
Average									
Run #2									
Tnk#									
Tnk#									
Average									
Run #3									
Tnk#									
Tnk#									
Average									
Run #4									
Tnk#									
Tnk#									
Average									
Run #5									
Tnk#									
Tnk#									
Average									
Run #6									
Tnk#									
Tnk#									
Average									

Test No: _____

CHARCOAL IGNITION DATA SHEET
METEOROLOGICAL AND AMBIENT DATA
RUN # _____

Date: _____

Charcoal Ignition Method _____

Ambient Enclosure Temperature ($^{\circ}\text{F}$):

Before Test: _____

During Test: Min: _____ Max: _____

After Test: _____

Ambient Enclosure Humidity (%):

Before Test: _____

During Test: Min: _____ Max: _____

After Test: _____

Outside Wind Speed (mph):

Before Test: _____

During Test: Min: _____ Max: _____

After Test: _____

Outside Wind Direction: _____

Recorded by: _____

APPENDIX D OBSERVATION AND CHECK LIST SHEETS

The following sheets (attached) are suggested to be for use in performing the test runs.

- a) Observations
- b) OVA Check List
- c) Stack and Atmospheric Conditions Check List
- d) TCA Trays Check List
- e) Fluid Ignition Procedure Check List
- f) Alcohol Ignition Procedure Check List
- g) Electric Wand (Probe) Ignition Procedure Check List
- h) Paraffin Cubes Ignition Procedure Check List
- i) Wood Chips Ignition Procedure Check List

Test No: _____

Date: _____

CHARCOAL IGNITION PROJECT
OBSERVATIONS
RUN # _____

IGNITION METHOD:

- ☐ Fluid
- ☐ Electric
- ☐ Wood Chips
- ☐ Alcohol
- ☐ Paraffin Cubes
- ☐ Other _____

COMMENTS: _____

IGNITION OBSERVATIONS

Time	Comments
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

% ash after 25 minutes _____

(Note: Observations should include time of flame out
and % ash, time at 70% ash, % ash at 25 minutes, flame
on time and % ash)

COMMENTS: _____

CHARCOAL IGNITION CHECK-LIST
ORGANIC VAPOR ANALYZER

Test # _____

Date: _____

Run # _____

Recorded by: _____

Start-Up

- ☐ Blow out probe filter with compressed air
- ☐ Turn on battery charger
- ☐ Place pump switch to on position
- ☐ Place instrument switch to on position
- ☐ Open two hydrogen valves
- ☐ Allow the instrument to warm up for 5 minutes
- ☐ Push red ignition button for 1-2 seconds, meter will show movement

Pre-Test

- ☐ Leak check probe
- ☐ Zero check
- ☐ Span check
- ☐ Check hydrogen pressure (>500 psi)

Post-Test

- ☐ Span check
- ☐ Zero check
- ☐ Leak check

CHARCOAL IGNITION CHECK-LIST
STACK & ATMOSPHERIC CONDITIONS

Test # _____

Date: _____

Run # _____

Recorded by: _____

Pre-Test

- ☐ Verify flow rate with velocity traverse
- ☐ Record ambient temperature
- ☐ Record ambient humidity
- ☐ Record wind speed and direction
- ☐ Record start time

Post-Test

- ☐ Record ambient temperature
- ☐ Record humidity
- ☐ Record wind speed and direction

CHARCOAL IGNITION CHECK-LIST

TCA TRAYS

Test # _____

Date: _____

Run # _____

Recorded by: _____

Pre-Test

- ☐ Record exhaust stack static pressure
- ☐ Leak check TCAs
- ☐ Attach filters/nozzles
- ☐ Position TCA nozzles in center of stack, pointing downstream
- ☐ Seal sampling ports
- ☐ Attach static tubes
- ☐ Fill trap container 3/4 full with dry ice
- ☐ Record initial tank vacuum on the TCA data sheet

Post-Test

- ☐ Leak check
- ☐ Pack traps full with dry ice, cover with cloth and tape

BBQ PROTOCOL DEVELOPMENT PROJECT - PROCEDURES USED TO LIGHT
BRIQUETTES

Test # _____

Date: _____

Run # _____

Recorded By: _____

FLUID IGNITION PROCEDURE

- [] RETRIEVE charcoal briquettes from the environmentally controlled storage area. Write down the time removed, ambient temp. and the relative humidity of this office, and the run No. on the bag.
- [] TARE scale with an empty fluid bottle and fill with 75 grams of lighter fluid.
- [] POUR briquettes into metal tray.
- [] TARE scale and select unbroken briquettes from tray adding to the grate until you reach 2 lbs (907) grams to the nearest briquette. Note actual weight to nearest gram.
- [] SEAL bag and place on a non conductive surface.
- [] POSITION BBQ in fireplace with the bottom setting on the floor of the fireplace and randomly arrange briquettes within standard 8.5 diameter template. Remove the template replacing any briquettes that fall to their original locations. Make sure BBQ is centered 2" from rear wall and BBQ vents are open.
- [] SYNCHRONIZE watches and check to ensure all testers are ready to go (if recent test or preconditioning run has not preceded this do so before running test now).
- [] RECORD background ppm from OVA.
- [] START timing as you gently squirt fluid onto briquettes.
- [] WAIT 1 minute after you've squirted the lighter fluid then light briquettes. Do not allow the unburned portion of the match to fall onto the BBQ.
- [] OBSERVE the burn recording the following:
 - Time test began
 - Time of flame out and %ash
 - Time at 70 %ash
 - %Ash at 25 minutes
 - Flame on time and %ash

- [] AT flame out insert T/C plate 4.5" over center of briquettes.
- [] AFTER test is over remove T/C and photograph the BBQ in fireplace at approximately a 60° angle.
- [] REMOVE BBQ and photograph top view.
- [] DUMP briquettes into pail of water to extinguish.
- [] CLEAN BBQ with water and a Scotch Brite pad or equivalent in preparation for the next test.
- [] DRY BBQ with a paper towel.
- [] RETURN briquettes to storage area if they have been in test area for 45 minutes or more (note time returned) else you may use them for your next test. Write time returned on bag.

BBQ PROTOCOL DEVELOPMENT PROJECT - PROCEDURES USED TO LIGHT
BRIQUETTES

Test # _____ Date: _____

Run # _____ Recorded By: _____

ALCOHOL IGNITION PROCEDURE

- [] MEASURE out 2 fluid oz. of fuel into the fire ring.
- [] RETRIEVE charcoal briquettes from the environmentally controlled storage area. Write down the time removed, ambient temp. and the relative humidity of this office, and the run No. on the bag.
- [] POUR briquettes into metal tray.
- [] TARE scale and select unbroken briquettes from tray adding to the grate until you reach 2 lbs (907) grams to the nearest briquette. Note actual weight to nearest gram.
- [] SEAL bag and place on a non conductive surface.
- [] CHECK and record background ppm from OVA before putting BBQ in fireplace.
- [] POSITION BBQ in fireplace with the bottom setting on the floor of the fireplace remove the grate and place fire ring in the center of the BBQ below the grate. Replace the grate and randomly arrange briquettes within the standard 8.5 diameter template. Remove the template replacing any briquettes that fall to their original locations. Make sure BBQ is centered 2" from rear wall and BBQ vents are open.
- [] CHECK background ppm once again before running test.
- [] TEST begins when the fire ring is lit.
- [] OBSERVE the burn recording the following:
 - Time test began
 - Time of flame out and %ash
 - Time at 70 %ash
 - %Ash at 25 minutes
 - Flame on time and %ash
- [] AT flame out insert T/C plate 4.5" over center of briquettes.

- [] AFTER test is over remove T/C and photograph the BBQ in fireplace at approximately a 60° angle.
- [] REMOVE BBQ and photograph top view.
- [] DUMP briquettes into pail of water to extinguish.
- [] CLEAN BBQ and fire ring with water and a Scotch Brite pad or equivalent in preparation for the next test.
- [] DRY BBQ with a paper towel.
- [] RETURN briquettes to storage area if they have been in test area for 45 minutes or more (note time returned) else you may use them for your next test. Write time returned on bag.

BBQ PROTOCOL DEVELOPMENT PROJECT - PROCEDURES USED TO LIGHT
BRIQUETTES

Test # _____

Date: _____

Run # _____

Recorded By: _____

ELECTRIC WAND IGNITION PROCEDURE

- ☐ RETRIEVE charcoal briquettes from the environmentally controlled storage area. Write down the time removed, ambient temp. and the relative humidity of this office, and the run No. on the bag.
- ☐ POUR briquettes into metal tray.
- ☐ TARE scale and select unbroken briquettes from tray adding to the grate until you reach 2 lbs (907) grams to the nearest briquette. Note actual weight to nearest gram.
- ☐ SEAL bag and place on a non conductive surface.
- ☐ PLACE BBQ in fireplace as above.
- ☐ POSITION wand on top of a solid single layer of briquettes just large enough in diameter to exceed the wand diameter.
- ☐ PILE remaining briquettes on top of the wand to maximize contact between the heating element and the charcoal.
- ☐ POSITION T/C 4.5" above briquettes.
- ☐ TESTING begins when wand is plugged in.
- ☐ RUN test as above except remove the wand without major disturbance of the briquettes at 10 minutes. Note the ash %.
- ☐ OBSERVE the burn recording the following:
 - Time test began
 - Time of flame out and %ash
 - Time at 70 %ash
 - %Ash at 25 minutes
 - Flame on time and %ash
- ☐ AT flame out insert T/C plate 4.5" over center of briquettes.
- ☐ AFTER test is over remove T/C and photograph the BBQ in fireplace at approximately a 60° angle.

- [] REMOVE BBQ and photograph top view.
- [] DUMP briquettes into pail of water to extinguish.
- [] CLEAN BBQ with water and a Scotch Brite pad or equivalent in preparation for the next test.
- [] DRY BBQ with a paper towel.
- [] RETURN briquettes to storage area if they have been in test area for 45 minutes or more (note time returned) else you may use them for your next test. Write time returned on bag.

BBQ PROTOCOL DEVELOPMENT PROJECT - PROCEDURES USED TO LIGHT
BRIQUETTES

Test # _____

Date: _____

Run # _____

Recorded By: _____

PARAFFIN CUBES IGNITION PROCEDURE

- [] RETRIEVE charcoal briquettes from the environmentally controlled storage area. Write down the time removed, ambient temp. and the relative humidity of this office, and the run No. on the bag.
- [] POUR briquettes into metal tray.
- [] TARE scale and select unbroken briquettes from tray adding to the grate until you reach 2 lbs (907) grams to the nearest briquette. Note actual weight to nearest gram.
- [] SEAL bag and place on a non conductive surface.
- [] RETURN briquettes to the dispensing tray.
- [] BREAK the seal only on the 3 cubes to be used and place them on the grate in a position such that they form the sides of an equilateral triangle. The cubes should be symmetrically centered and positioned so that there is 3/4" distance between the closest points of the cubes.
- [] POSITION BBQ in fireplace with the bottom setting on the floor of the fireplace and have briquettes in tray ready to pile on after ignition. Make sure BBQ is centered 2" from rear wall and BBQ vents are open.
- [] POSITION BBQ in fireplace
- [] START the test at ignition.
- [] PILE the briquettes onto the burning cubes within the standard 8.5 diameter template as quickly as possible and note the time to do this. Remove the template replacing any briquettes that fall to their original locations.

[] OBSERVE the burn recording the following:

Time test began
Time of flame out and %ash
Time at 70 %ash
%Ash at 25 minutes
Flame on time and %ash

[] AT flame out insert T/C plate 4.5" over center of briquettes.

[] AFTER test is over remove T/C and photograph the BBQ in fireplace at approximately a 60° angle.

[] REMOVE BBQ and photograph top view.

[] DUMP briquettes into pail of water to extinguish.

[] CLEAN BBQ with water and a Scotch Brite pad or equivalent in preparation for the next test.

[] DRY BBQ with a paper towel.

[] RETURN briquettes to storage area if they have been in test area for 45 minutes or more (note time returned) else you may use them for your next test. Write time returned on bag.

BBQ PROTOCOL DEVELOPMENT PROJECT - PROCEDURES USED TO LIGHT
BRIQUETTES

Test # _____ Date: _____

Run # _____ Recorded By: _____

WOOD CHIPS - IGNITION PROCEDURE

- [] RETRIEVE charcoal briquettes from the environmentally controlled storage area. Write down the time removed, ambient temp. and the relative humidity of this office, and the run No. on the bag.
- [] POUR briquettes into metal tray.
- [] TARE scale and select unbroken briquettes from tray adding to the grate until you reach 2 lbs (907) grams to the nearest briquette. Note actual weight to nearest gram.
- [] SEAL bag and place on a non conductive surface.
- [] RETURN briquettes to dispensing tray.
- [] TARE scale with grate.
- [] PLACE chips in BBQ by taking handfuls and sprinkling them over the center of the grate. Allow most chips to fall through and some to remain on the grate. Continue this until the scale indicates you have placed 50 grams in the BBQ.
- [] POSITION BBQ in fireplace with the bottom setting on the floor of the fireplace and randomly arrange briquettes within standard 8.5 diameter template above the wood chips. Remove the template replacing any briquettes that fall to their original locations. Make sure BBQ is centered 2" from rear wall and BBQ vents are open.
- [] TESTING begins on ignition.
- [] OBSERVE the burn recording the following:
 - Time test began
 - Time of flame out and %ash
 - Time at 70 %ash
 - %Ash at 25 minutes
 - Flame on time and %ash
- [] AT flame out insert T/C plate 4.5" over center of briquettes.

- [] AFTER test is over remove T/C and photograph the BBQ in fireplace at approximately a 60° angle.
- [] REMOVE BBQ and photograph top view.
- [] DUMP briquettes into pail of water to extinguish.
- [] CLEAN BBQ with water and a Scotch Brite pad or equivalent in preparation for the next test.
- [] DRY BBQ with a paper towel.
- [] RETURN briquettes to storage area if they have been in test area for 45 minutes or more (note time returned) else you may use them for your next test. Write time returned on bag.

APPENDIX E LABORATORY CHECK LIST AND DATA SHEETS

The following sheets are suggested for use in performing laboratory analysis.

- a) Oxygen Analysis By GC/TCD Checklist
- b) Varian TCA/FID Checklist
- c) SCAQMD TCA/FID Checklist
- d) Trap Burning Checklist
- e) TCA/NDIR Checklist
- f) TCA Tray Preparation Checklist

OXYGEN ANALYSIS BY GC/TCD CHECKLIST

INSTRUMENT READY

- ☐ 500 psig (min) all tank pressures
- ☐ analysis request received
- ☐ confirm sample identifications
- ☐ label chromatogram with test identification and analyst name
- ☐ inject dry air standard twice
- ☐ repeatability within 5%

ANALYSIS

- ☐ label chromatogram with sample identification
- ☐ inject sample in duplicate
- ☐ repeatability within 5%

- ☐ inject standard twice after each 5 samples (optional)
- ☐ area within 10% of first injection
- ☐ repeatability within 5%

DRIFT CHECK

- ☐ reinject standard twice at end
- ☐ repeatability within 5%
- ☐ area within 10% of first injection
if not, void analysis to last valid standard
reanalyze voided samples

CALCULATION

- ☐ use avg first standard

percent oxygen:

peak area sample (avg) X 20.95 X final sample pressure

peak area first standard X received sample pressure

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VARIAN TCA/FID CHECKLIST

INSTRUMENT SETUP

- [] Varian 3400 or equivalent, set up for TCA/FID, except:
- [] 2'X1/8" Tenax 80/100, plus 6'X1/8" Chromosorb 106 80/100
- [] 6'X1/8" Hayesep Q post-oxidizer
- [] post-methanizer hydrogen eliminated
- [] pre-methanizer flow at 10 mL/min
- [] temperature programming

INSTRUMENT READY

- [] 500 psig min tank pressure, all gases
- [] column head pressure at 35-40 psig
- [] oven temperature at 50 C
- [] receive analysis request
- [] confirm sample location and identity
- [] label chromatogram with analyst name and test identification
- [] inject multicomponent standard
- [] temperature programming at 5 min
- [] check retention times, separation
- [] inject high standard twice
- [] inject mid standard twice
- [] inject low standard twice
- [] areas within 5% of first injection same standard

ANALYSIS OF TRAP BULB SAMPLES

- [] label chromatogram with sample identification
- [] inject sample
- [] scan for peak areas below standards

VARIAN TCA/FID CHECKLIST

ANALYSIS OF TRAP BULB SAMPLES (CONTD)

- ☐ reinject sample
- ☐ area within 5% of first injection
- ☐ inject dilute standard if necessary to bracket sample

- ☐ inject mid-standard twice after every five samples (optional)

ANALYSIS OF MULTICOMPONENT SAMPLES

- ☐ inject sample
- ☐ backflush at 5 min with temperature programming
- ☐ reinject sample
- ☐ areas within 5% of first injection
- ☐ inject diluted standard, if necessary, to bracket sample components

- ☐ inject mid-standard twice after every five samples (optional)

DRIFT CHECK

- ☐ inject high standard twice
- ☐ inject mid standard twice
- ☐ inject low standard twice
- ☐ area within 5% of duplicate
- ☐ average area within 10% of first average
- ☐ if area not within 10%, void to last valid standard
- ☐ repeat voided analyses

CALCULATIONS

- ☐ use appropriate standard

analyte ppm:

area sample (avg) X conc standard, ppm X final pressure

area standard (avg) X initial pressure

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SCAQMD TCA/FID CHECKLIST

INSTRUMENT READY

- ☐ 500 psig (min) tank pressure, all gases
- ☐ request for analysis
- ☐ confirm sample identification
- ☐ label chromatogram with analyst name and test identification

- ☐ carrier through oxidizer and methanizer
- ☐ inject multicomponent standard
- ☐ temperature program
- ☐ note backflush time
- ☐ set timer for backflush time

- ☐ inject three CO standards (min)
- ☐ clean (backflush/heat) columns
- ☐ inject three blanks (min)
- ☐ temperature program each blank same as multicomponent standard
- ☐ record blank values
- ☐ blank values less than CO standard

ANALYSIS

- ☐ label chromatogram with sample identification
- ☐ inject sample
- ☐ temperature program same as multicomponent standard
- ☐ check backflush for integration marks
- ☐ reinject until two valid integrations
- ☐ but not more than four times

- ☐ reinject standards twice every five samples (optional)

SCAQMD TCA/FID CHECKLIST

DRIFT CHECK

- ☐ reinject standard five times at end
- ☐ if drift less than 15%, grand average all stds
- ☐ if drift is over 15%, void to last valid standard
- ☐ reanalyze voided samples

CALCULATIONS

- ☐ average valid integrations each sample
- ☐ or all integrations if no valid ones obtained

- ☐ subtract average blank values, if noted

analyte ppm (v/v):

net sample area (avg) X std conc, ppm X final pressure

standard area (avg) X initial pressure

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TRAP BURNING CHECKLIST

INSTRUMENT READY

- [] 500 psig (min) tank pressure
- [] set carrier flow
- [] set oxygen flow
- [] trap furnace at 600 C
- [] combustion furnace at 850 C
- [] inject 1% methane
- [] inject 1% carbon dioxide
- [] peaks within 5%
- [] purge and evacuate collection vessels
- [] ice water trap

SYSTEM BLANK

- [] obtain previously cleaned trap
- [] connect probe arm to combustion tube
- [] connect to carrier
- [] leak check connections
- [] connect collection vessel
- [] switch to collect when carbon dioxide peak returns to baseline
- [] heat per method
- [] stop collection after collection vessel is near atm pressure
- [] pressurize to 900-920 mm Hg
- [] record

TRAP BURNING

- [] receive analysis request
- [] identify samples
- [] arrange burning sequence from low to high values, if possible
- [] place selected trap in dry ice
- [] connect probe arm to combustion tube
- [] connect trap to carrier
- [] leak check connection
- [] connect collection vessel
- [] collect when trace returns to zero, or 4 min, whichever is first
- [] heat trap
- [] decoke when trace returns to zero
- [] return to normal carrier flow
- [] stop collection
- [] disconnect collection vessel
- [] pressurize to 900-920 mm Hg
- [] record pressure

EQUIPMENT STANDBY

- [] reduce combustion tube temperature to 500 C
- [] purge water trap
- [] reduce gas flows to approx 5 mL/min

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TCA/NDIR CHECKLIST

INSTRUMENT READY

- [] 500 psig (min) tank pressure
- [] carrier at 100 psig (or adequate for flow control)
- [] flow set to 80 mL/min
- [] large loop
- [] bypass valve position

- [] analysis request received
- [] identify samples
- [] label chromatogram with test identification and analyst name
- [] inject check standard twice
- [] repeatability within 5%

LIMIT OF DETECTION (LOD)

- [] run baseline for approx 1 min.
- [] inject 100 ppm CO₂ standard (bypass), duplicate
- [] measure baseline height, mm
- [] measure peak height, avg, mm
- [] estimate LOD:

$$\frac{3 \times \text{baseline mm} \times 100 \text{ ppm}}{\text{peak height, avg, mm}} \quad (\text{MUST BE 30 PPM OR LOWER})$$

COMBUSTION EFFICIENCY

- [] inject 1% CH₄ twice
- [] average area
- [] inject 1% CO₂ twice
- [] average area
- [] calculate combustion efficiency:

$$\frac{\text{area CH}_4, \text{ avg} \times \text{percent CO}_2 \times 100}{\text{area CO}_2, \text{ avg} \times \text{percent CH}_4} \quad (\text{MUST BE 95\% OR MORE})$$

TCA/NDIR CHECKLIST

TRAP BULB ANALYSIS

- ☐ label chromatogram with sample identification
- ☐ inject sample twice
- ☐ check repeatability
- ☐ check sample response (must be in linear range)
if not, inject matching standard twice
and/or change sample loop size
- ☐ inject check standard twice every 5 samples (optional)

MULTICOMPONENT SAMPLES

- ☐ dry ice IPA slurry
- ☐ boiling water
- ☐ room temp water
- ☐ carrier through columns
- ☐ ice columns
- ☐ label chromatogram with sample identification
- ☐ inject sample
- ☐ temperature program
- ☐ screen results for peak areas beyond linear range
- ☐ reinject sample
- ☐ inject matching standards twice if necessary
- ☐ switch to small loop if necessary
- ☐ follow above procedure
- ☐ inject check standards twice every 5 samples (optional)

DRIFT CHECK

- ☐ large loop
- ☐ reinject check standard twice at end
- ☐ average area within 10% of first injection
- ☐ if area not within 10% of first injection
void to last valid standard
repeat voided analyses

TCA/NDIR CHECKLIST

CALCULATION

- [] within linear range
use avg area of first check standard
- [] out of linear range
use avg area of matching standard

analyte ppm:

sample area (avg) X standard conc, ppm X final sample press

standard area (avg) X received sample press

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TCA TRAY PREPARATION CHECKLIST

TANK CLEANING

- ☐ get disposal notice
- ☐ purge per disposal instructions:
 - if NMHC<100 ppm, purge 5X
 - if NMHC>100 ppm, but<1000 ppm, purge 10X
 - if NMHC>1000 ppm, purge 10X, and re-test before use
- ☐ final evacuation to 10mm Hg or less
- ☐ label "clean", with date/time, gage reading, and initials

FLOW CONTROLLER (F/C) CLEANING

- ☐ flush F/C for 5 min at magnahelic reading of 2-3 with ambient air
- ☐ set flow to magnahelic reading of 2.0
- ☐ close vacuum line until F/C is under only 5" Hg vacuum
- ☐ reject if magnahelic reading changes by more than 0.2
- ☐ label "clean", date and initials

TRAP CLEANING

- ☐ attach trap to HC-free air line
- ☐ air purge on
- ☐ heat to dull red from air line to outlet
- ☐ cap traps when not in use
- ☐ label "clean", date and initials

FILTER CLEANING

- ☐ attached filter to HC-free air
- ☐ air purge on
- ☐ heat to dull red from air line to outlet
- ☐ place filters in clean plastic bag when not in use
- ☐ label bag "clean" date and initials

TRAY ASSEMBLY

- ☐ equipment request and worksheets received
- ☐ locate clean equipment
- ☐ check tank gage readings
- ☐ reject if gage changes by >2 in Hg
- ☐ measure tank pressure with manometer
- ☐ record
- ☐ assemble
- ☐ tighten all fittings
- ☐ record equipment numbers

CONTD

TCA TRAY PREPARATION CHECKLIST

- [] rapidly open and close tank valve
- [] set F/C reading to "2.5" inches vacuum
- [] wait ten minutes
- [] re-read F/C
- [] passes if needle has not deflected >0.2 " either way
- [] if pass label ass'y "leak checked", date and initials
- [] record
- [] record equipment numbers on Chain of Custody

- [] if failed, reject equipment, submit for repair

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